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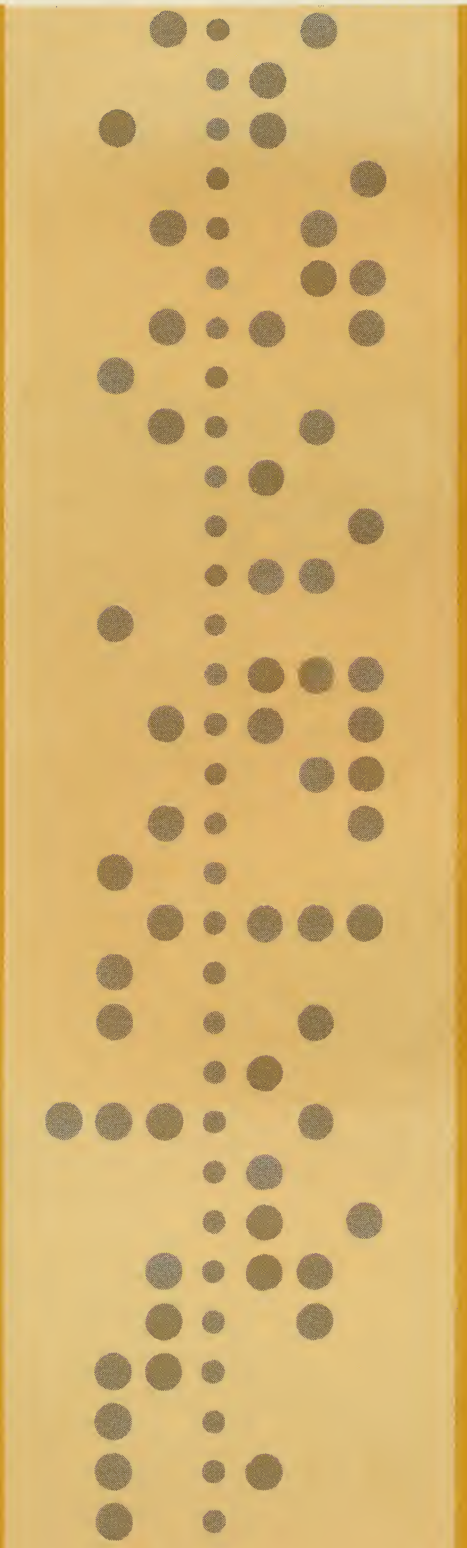
July 20, 1965

U.S. GOVERNMENT RESEARCH & DEVELOPMENT REPORTS



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FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

U. S. DEPARTMENT OF COMMERCE / NATIONAL BUREAU OF STANDARDS / INSTITUTE FOR APPLIED TECHNOLOGY

July 20, 1965 / Volume 40, Number 14

U.S. Government

RESEARCH AND DEVELOPMENT REPORTS

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Reports of the National Aeronautics and Space Administration and the Atomic Energy Commission can be ordered from the Clearinghouse. They are abstracted in the following journals available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

NUCLEAR SCIENCE ABSTRACTS, Atomic Energy Commission, $30 a year domestic, $37 foreign, $1.75 single copy plus 25 percent foreign mailing.

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS. National Aeronautics and Space Administration, $33.00 a year domestic, $42.00 foreign, $2.50 single copy plus 25 cents foreign mailing.

U.S. DEPARTMENT OF COMMERCE
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Use of funds for this publication approved by the Director of the Bureau of Budget, June 30, 1961.

special ANNOUNCEMENTS

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RESEARCH highlights

Reports of current high industrial interest

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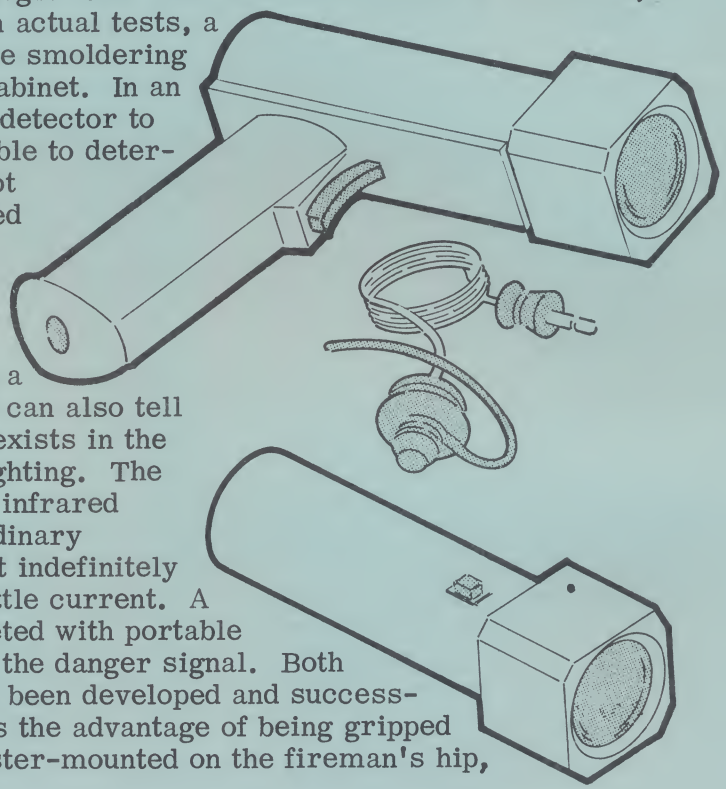
HEAT-SEEKING DEVICE LOCATES HIDDEN FIRES

(Order AD-615 634 Pre-Prototype Hand-Held Fire Detectors, HC $2.00/ MF 50 cents.)

A remarkably simple and easy-to-handle heat-seeking device that tells firemen where to look for hidden fires has been developed for Civil Defense authorities by the Singer Co. The device works just as well in smoke-filled areas as in rooms or buildings where no evidence of fire or smoke is apparent. All that is necessary is for the fireman to point the flashlight-size device around a room and listen for a signal that indicates the location of the flame, ember, or other heat source. In actual tests, a fireman used the device to locate smoldering rags behind a huge metal wall cabinet. In an auto fire a firefighter using the detector to scan under the dashboard was able to determine that the doused fire was not entirely out. Firemen who tested the device for Civil Defense authorities are enthusiastic about the sensor's potential. It can, for example, indicate where live embers still exist in a smoke-filled gutted building. It can also tell where the most dangerous fire exists in the early detection stages of fire fighting. The device is officially known as an infrared detector. It is powered with ordinary flashlight batteries that will last indefinitely because the device uses very little current. A small earphone, like that marketed with portable radios, is used to communicate the danger signal. Both flashlight and pistol styles have been developed and successfully tested. The pistol type has the advantage of being gripped more readily, and it can be holster-mounted on the fireman's hip, ready for use in an emergency.



RESEARCH REVIEWS PACKAGED for INDUSTRY

by

The Institute for Applied Technology
NATIONAL BUREAU OF STANDARDS

Highlighted here are seven recent issues in the series, A Review of Selected U. S. Government Research and Development Reports.

The publications contain resumes, abstracts and bibliographies of Federally sponsored research and development reports gathered under titles of special interest to industry.

They and the reports they refer to may offer ideas for product development or suggest means of reducing costs. The series, as well as most of the reports reviewed in it, are available from the Clearinghouse. New titles are in process. Please order by OTR number.

FLUID AMPLIFIERS

(Order OTR-112 Fluid Amplification, available free from the Clearinghouse.)

Fluid amplifiers are still in an early stage of development, but considerable Government R and D effort is being expended toward their use in military and space applications where the potential advantages outweigh the development costs. Government effort is aimed at describing theory and developing design procedures, assemblies, fabrication methods, instrumentation, and power supplies. While the bulk of the reports available from the Clearinghouse on this effort is obviously military and space oriented, OTR-112, a review prepared by the NBS Institute for Applied Technology, concludes that they should be useful also to those interested in civilian technological progress. The review notes that amplification involves the control of a powerful flow of some medium by a weaker force. A fluid amplifier uses a fluid such as water or air. It has distinct advantages over electronic counterparts in that it can operate in extreme environments such as high heat, high radiation, and high vibration and shock, which are often incompatible with electronic devices. In addition, a no-moving-parts amplifier is possible for control purposes, thereby cutting down on maintenance and repairs because there are no parts to break down. Like electronic counterparts, fluid amplifiers can also be cascaded so that one component acts as a preamplifier for the succeeding stage.

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01 AERONAUTICS

Includes aerodynamics; aeronautics; aircraft; aircraft flight control and instrumentation; and air facilities. See also related fields: 16 Missile Technology, 17 Navigation, Communications, Detection, and Countermeasures, 20 Physics, and 22 Space Technology..... 1, S-1

02 AGRICULTURE

Includes agricultural chemistry; agricultural economics; agricultural engineering; agronomy and horticulture; animal husbandry; and forestry. See also related field: 06 Biological and Medical Sciences..... S-2

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TECHNICAL
ABSTRACT
BULLETIN

01. Aeronautics

AD-615 207 Div. 09/5

Firestone Flight Sciences Lab., Calif. Inst. of Tech., Pasadena.
A CORRELATION OF CONVECTIVE HEAT TRANSFER AND RECOVERY TEMPERATURE DATA FOR CYLINDERS IN COMPRESSIBLE FLOW,
by C. Forbes Dewey, Jr. 20 Aug 64, 8p
Pub. no. 598
Contract DA31 124ARO D33
Unclassified report

Pub. in International Journal of Heat and Mass Transfer v8 p245-52 1965 (Copies available only to DDC users).

Descriptors: (*Correlation techniques, Aerodynamic heating), (*Heat transfer, Cylindrical bodies), (*Compressible flow, Cylindrical bodies), Convection, Fluid mechanics, Continuum mechanics, Reynolds number, Transport properties.

AD-615 212 Div. 09/5, 09/6, 25/8
CFSTI Prices: HC$1.00 MF$0.50

Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio.
TEMPERATURE OF A PLATE IN A SUPERSONIC FLOW WITH RADIATION TAKEN INTO ACCOUNT,
by I. N. Sokolova. 5 Apr 65, 25p FTD-MT-64-307
TT 65-62212
Unclassified report

Edited Machine trans. of mono. Sbornik Teoreticheskikh Rabot po Aerodinamike (Collection of Theoretical Works on Aerodynamics) Moscow 1957 p206-21.

Descriptors: (*Flat plate models, Temperature), (*Supersonic flow, Flat plate models), (*Thermal radiation, Flat plate models), Thermal conductivity, Laminar boundary layer.

A method is given for calculating the influence of radiation in the computation of temperature of a plate streamlined by a flow of gas of high speed. These cases are considered: (1) absolutely heat-conducting plate, (2) absolutely nonheat-conducting plate, and (3) plate of finite thermal conduction. It is shown that at high Mach numbers, radiation strongly lowers the temperature of the plate. Graphs and tables necessary for the calculations are presented. (Author)

AD-615 265 Div. 01/1
CFSTI Prices: HC$2.00 MF$0.50

National Aviation Facilities Experimental Center, Atlantic City, N. J.
EVALUATION OF BAROMETRIC ALTIMETRY AT LOW ALTITUDE.
Final rept.,
by Donald J. Bourque, Jan 65, 31p
Proj. 320 205 01V
SRDS RD-65-7 Unclassified report

Descriptors: (*Altimeters, Barometric pressure), Low altitude, Errors, Level flight, Approach, Jet transport planes.

An evaluation was conducted to determine the mean and standard deviation of errors in determining a height of 100 feet above the runway by utilizing the barometric altimetry systems aboard the Federal Aviation Agency Boeing 720 (N-113) and Convair 880 (N-112) on Instrument Landing System (ILS) approaches. Operational altimetry system errors were determined by taking the difference between altimeter indicated height recorded by airborne cameras and aircraft altitude recorded by phototheodolites. Corrections for the altimeter setting error and the flight manual value of the error of the static system were applied to the operational altimetry system error to obtain the calculated altimetry system error. Based on the results of the evaluation, it was concluded that a height of 100 feet could have been determined during descent to an average standard deviation of 5.2 feet and 7.7 feet for the Boeing 720 and the Convair 880 respectively, and during level flight to an average standard deviation of 6.5 feet and 8.4 feet for the Boeing 720 and the Convair 880 respectively, provided the barometric altimetry systems were corrected by the amount of the mean error for each case. (Author)

AD-615 273 Div. 25/8
CFSTI Prices: HC$2.00 MF$0.50

Harry Diamond Labs., Washington, D. C.
EQUILIBRIUM THERMODYNAMIC PROPERTIES OF AIR BEHIND INCIDENT NORMAL SHOCK WAVES,
by Harry J. Davis. 30 Mar 65, 41p
Rept. no. TM-65-17
Projs. 30300, 1P010501A008
Unclassified report

Descriptors: (*Thermodynamics, Air), (*Air, Thermodynamics), (*Tables, Thermodynamics), Chemical equilibrium, Shock waves.

The equilibrium temperature, density, and pressure of air behind incident normal shock waves have been calculated. The resulting tables include the effects of chemical reactions, excitation, dissociation, ionization, van der Waal and Coulomb forces. The tables are presented as functions of the ratio of the density behind the shock wave to the density at standard conditions in steps of 0.2. The temperature behind the shock wave T2 is a parameter which ranges from 2000K to 16,000K in 1000K steps. Two sets of tables, for initial conditions of 273.15 and 300.0K, are presented. The densities of air, as a real and as an ideal gas, are compared. (Author)

AD-615 280 Div. 09/7
CFSTI Prices: HC$3.00 MF$0.75

Boeing Scientific Research Labs., Seattle, Wash.
OBSTACLE-INDUCED FLOW RECIRCULATION,
by G. K. Timm. Mar 65, 73p
Flight sciences Lab. rept. no. FSL-94, D1-82-0423
Unclassified report

Also available from the author.

in the Coefficient of Aerodynamic Resistance in Determining Atmospheric Density on the Basis of Artificial-Satellite Deceleration. Optimum Analyzer Designs for a Radio-Frequency Mass Spectrometer with Two and Three Drift Spaces. Biological Effectiveness of a Number of Space-Flight Factors. Biological Effect of Cosmic Radiation in the Event that Solar Flares Occur on the Earth to Moon Route in Model Experiments. A Chamber Simulating the Conditions of Mars for Microbiological Research.

AD-615 454 Div. 12/6, 12/1, 32/6
CFSTI Prices: HC$6.00 MF$1.50

Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio.
SPACE AND INTERNATIONAL COOPERATION,
25 May 64, 266p FTD-MT-64-176
TT 65-62291

Unclassified report

Edited machine trans. of mono. Kosmos i Mezhdunarodnoe Sotrudnichestvo, Moscow, 1963, p1-256.

Descriptors: (*Space flight, Law), (*Law, Space flight), Foreign policy, Space communication systems, Radio-frequency, East Germany, United States Government, USSR, United Nations.

Contents:
On the 70th birthday of Yevgeniy Aleksandrovich Korovin
Legal regime of outer space at the contemporary level, by G. P. Zhukov
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Soviet literature on space law.

AD-615 517 Div. 12/6, 12/1, 12/2, 12/3, 12/4, 26/2
CFSTI Prices: HC$1.00 MF$0.50

RAND Corp., Santa Monica, Calif.
A MODEL FOR PROJECTING COSTS OF SPACE EXPLORATION,
by J. String. Apr 65, 24p Rept. no. P-3119

Unclassified report

Rept. prepared for presentation at a meeting of the American Statistical Association, Southern Calif. Chapter, 28 Jan 65.

Descriptors: (*Space flight, Costs), Manned spacecraft, Management planning, Decision making, Budgets, Production, Statistical analysis, Mathematical models.

A model was developed for determining the costs of advanced space hardware and for assessing the budgetary implications of integrated space exploration plans. The model has three basic characteristics: (1) it is a long-range planning model; (2) it estimates the resource implications of alternative NASA over-all space plans in such a way as to allow relating of resource requirements to the objective of these plans; and (3) its purpose is to provide, in part, a basis for making decisions on major activities to be pursued by NASA in the future. It is designed to yield projections of the budgetary implications of space activity plans under these rather serious data base limitations and technological and operational uncertainties. (Author)

AD-615 759 Div. 12/6, 12/1, 06/6
CFSTI Prices: HC$1.00 MF$0.50

General Electric Co., Philadelphia, Pa. Missile and Space Div.
A MISSION COST MODEL FOR FERRET SATELLITES.
Technical information series,
by H. C. Sebring. 1 May 65, 23p TIS65SD236

Unclassified report

Descriptors: (*Radar signals, Detection), (*Satellites (Artificial), Costs), (*Operations research, Satellites (Artificial)), Models (Simulations), Systems engineering, Probability, Wave transmission, Orbital trajectories.

An analytical model to evaluate ferret satellite systems is explicated. It may also be used to yield inputs for specific system definition. In addition to the general stochastic nature of radar signal detection, analyses are applied to the cases of unknown emitter bandwidths and to the detection of known frequencies. The conditions of emitter operation and overflight are included. The signal detection probability is implicitly an input to a cost effectiveness methodology which considers major parameters such as orbital altitude, payload weight, reliabilities, launching requirements and costs, weights and costs of satellites and ancillary equipment, and total mission cost to achieve objectives with predetermined confidence. Logic is drawn from the model to support the conclusion that, ignoring safety tolerances, the minimum orbital altitude related to the desired lifetime is preferred. Numerical examples are presented; however, the principal purpose of the paper is to document the analytical method. There is no application to specific systems that might be postulated. (Author)

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OTHER RESEARCH REPORTS AND RELATED MATERIAL

*Descriptors marked with an asterisk are included in the subject index

01. Aeronautics

AD-451 128 Field 01A, 14B
CFSTI Price: HC$2.00

Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
EFFECT OF SHOCK IMPINGEMENT ON THE HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS ON A CYLINDRICAL-LEADING-EDGE MODEL AT MACH NUMBER 19,
by L. G. Siler and H. E. Deskins. Nov 64, 30p
AEDC TDR-64-228
Contract AF40 600 1000, Proj. VT0424, Task 136607
Unclassified report

Descriptors: (*Aerodynamic configurations, Cylindrical bodies), (*Wind tunnel models, Cylindrical bodies), Hypersonic wind tunnels, Shock waves, Reynolds number, Pressure, Heat transfer.

Pressure and heat-transfer measurements on a cylindrical-leading-edge model with and without the influence of an impinging shock wave were made in Tunnel F at about Mach number 19 and Reynolds number of approximately 24,000 per inch. The configuration was evaluated through a sweep range from 0 to 75 deg while varying the shock generator angle from 0 to 40 deg. (Author)

N65-19276 Field 01B, 01C
CFSTI Prices: HC$2.00 MF$0.50

National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.
EFFECTS OF AIRCRAFT RELATIVE DENSITY ON SPIN AND RECOVERY CHARACTERISTICS OF SOME CURRENT CONFIGURATIONS,
by William D. Grantham and Sue B. Grafton.
Mar 65, 40p NASA-TN-D-2243
Unclassified report

Descriptors: (*Aircraft, Configuration), (*Aerodynamic characteristics, Aircraft), Spin, Recovery.

N65-19279 Field 01A, 01C
CFSTI Pices: HC$2.00 MF$0.50

National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.
A STUDY OF PRESSURE AND HEAT TRANSFER OVER AN 80 DEGREE SWEEP SLAB DELTA WING IN HYPERSONIC FLOW,
by Allen H. Whitehead, Jr. and James C. Dunavant.
Mar 65, 50p NASA-TN-D-2708
Unclassified report

Descriptors: (*Delta wings, Hypersonic characteristics), (*Hypersonic characteristics, Delta wings), Aerodynamic heating, Pressure.

N65-19280 Field 01C, 12A, 20K
CFSTI Prices: HC$2.00 MF$0.50

National Aeronautics and Space Administration, Langley Station, Va., Langley Research Center.
TECHNIQUES FOR EXAMINING STATISTICAL AND POWER-SPECTRAL PROPERTIES OF RANDOM TIME HISTORIES,
by Herbert A. Leybold. Mar 65, 45p
NASA-TN-D-2714
Unclassified report

Descriptors: (*Airframes, Loading (Mechanics)), (*Loading (Mechanics), Statistical analysis).

Patent 3,176,941 Field 01B

LOAD UNLOCKING AND ACTUATING THRUSTER.
Patent assigned to Army,
by Gilbert H. Skopp and Charles W. Boaz. 6 Apr 65
Unclassified patent

Available from Commissioner of Patents, Washington, D.C., 20231, $0.25

Descriptors: (*Jettisonable equipment, Explosive actuators), (*Locking fastener devices, Parachutes), Patents.

The thruster is operable sequentially to unlock and actuate a load device such as the main parachute of an aircraft escape system. A drogue parachute is locked to the container of the main parachute by two pins. The thruster is movable in its entirety to actuate the pins and the pilot parachute.

PB-167 270 Field 01B, 13F
CFSTI Prices: HC$3.00 MF$0.75

Institute for Aerospace Studies, Univ. of Toronto (Ontario).
EXPERIMENTAL STUDY OF THE AERODYNAMIC CHARACTERISTICS OF A MODEL OF AN AIR CUSHION VEHICLE IN HOVERING FLIGHT,
by B. W. Gowans. Feb 64, 78p
Technical note no. UTIAS-TN-74
Contract AF33 657 8451
AD 446 189
Unclassified report

Descriptors: (*Ground effect machines, Model tests), Aerodynamic characteristics, Hovering, Flight testing, Construction, Instrumentation, Calibration, Pitch, Ground effect, Ducted fans, Shrouded propellers, Gas flow, Pressure, Thrust, Lift, Performance (Engineering), Three-dimensional flow, Mathematical analysis.

A self-propelled model of an Air Cushion Vehicle has been built and flight tested on the UTIAS Circular Track Facility. A detailed study of the flow through the model has been made, and the jet mass and momentum fluxes have been measured. An augmentation curve and the basic static and dynamic stability characteristics in pitch have been obtained for the model while in hovering flight. (Author)

N65-19277 Field 21H, 22B
CFSTI Prices: HC$3.00 MF$0.75

National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.
THEORETICAL BOUNDARIES AND INTERNAL CHARACTERISTICS OF EXHAUST PLUMES FROM THREE DIFFERENT SUPERSONIC NOZZLES,
by Earl H. Andrews, Jr., Allen R. Vick, and Charlotte B. Craidon. Mar 65, 82p
NASA-TN-D-260

Unclassified report

Descriptors: (*Supersonic nozzles, Exhaust gases), (*Exhaust gases, Supersonic nozzles), Rocket motor nozzles.

N65-19703 Field 21I
CFSTI Prices: HC$1.75 MF$0.75

National Aeronautics and Space Administration, Washington, D. C.
HIGH ENERGY PROPELLANTS-A CONTINUING BIBLIOGRAPHY.
Mar 65, 104p NASA-SP-7002(01)

Unclassified report

Descriptors: (*Rocket propellants, Bibliographies), (*Bibliographies, Rocket propellants), (*Oxidizers, Bibliographies).

PB-167 420 Field 21D, 07C, 07E, 10C
CFSTI Prices: HC$2.00 MF$0.50

American Oil Co., Whiting, Ind.
BASIC STUDY OF SORPTION OF ORGANIC FUELS DURING OXIDATION AT ELECTRODES.
Quarterly rept. no. 11,
by Robert J. Flannery, Gerald Aronowitz, Ahmad Sam, and Donald C. Walker. Jul 64, 33p Rept. no. M64-204
Contract DA11 022ORD4023, Proj. 3472, ARPA Order 247-62, Task 5
AROD 3472:3; AD 444 431

Unclassified report

Descriptors: (*Fuels, Oxidation), (*Fuel cells, Electrodes), (*Sorption, Electrodes), (*Electrodes, Sorption), Electrochemistry, Tracer studies, Butane, Radioactive isotopes, Labeled substances, Adsorption, Metal films, Platinum, Adhesion, Hydrocarbons.

Studies of the sorption of radio-n-butane on a thin film platinum electrode in 1N H_2SO_4 at 25 C and at potentials in the range of 0 to 1.5V (NHE) were continued. Maximum adsorption occurs at about +0.4V (NHE), near the zero charge potential. At lower concentration of butane, coverage decreases and the potential of maximum adsorption shifts to more negative values. Fractional coverage was not determined but was estimated to be of the order of tenths. Use of tantalum underlayment to improve the adhesion of platinum film electrodes to mica has given promising preliminary results. Capacitance work directed toward the temperature dependence of methanol adsorption continued, with emphasis on the state of the electrode surface resulting from electrode pretreatment and potential programming. Greatest reproducibility of capacity values results from prolonged pretreatment near hydrogen evolution and avoidance of the oxide region. A sputtered platinum on platinum-foil electrode gave capacity-potential behavior qualitatively similar to that found for bright platinum which indicated a surface roughness for the sputtered and annealed film of about 10. (Author)

PB-167 437 Field 21C, 21D
CFSTI Prices: HC$3.00 MF$0.75

General Electric Co., Cincinnati, Ohio.
EFFECTS OF IMPURITIES OF CESIUM FUEL UPON ION ENGINES.
Rept. for 1 Jun 62-15 Apr 63,
by B. C. Merten, A. Skerbele, and M. L. Bromberg.
Jun 63, 54p
Contract AF33 657 9163, Proj. 3048, Task 304804
ASD TDR-63-476 P1; AD 416 449

Unclassified report

See also AD-603 631.

Descriptors: (*Ion engines, Fuel contamination), (*Fuel contamination, Ion engines), (*Cesium, Fuels), Impurities, Temperature, Ionization, Chemisorption, Porous metals, Tungsten, Silicon, Titanium, Iron, Nickel, Chromium, Aluminum, Lead, Alkali metals, Lithium, Sodium, Potassium, Rubidium, Barium, Magnesium, Aluminum, Copper, Tin, Zinc, Oxygen, Contamination, Vapor pressure.

The presence of certain impurities in cesium fuel raises the critical temperature of ionization on a particular emitter surface, thereby decreasing the thermal efficiency of the surface ionization ion engine. Critical temperature curves of cesium with selected impurities are compared to those of pure cesium on the same porous tungsten emitter surface. The effect of the impurities is then determined by any deviation in the curves. (Author)

22. Space Technology

PB-167 328 Field 22B
CFSTI Prices: HC$3.00 MF$0.75

IIT Research Inst., Chicago, Ill.
RESEARCH AND DEVELOPMENT OF DESIGN CONCEPTS FOR SEALING APPLICATIONS IN AEROSPACE VEHICLE CABINS.
Rept. for 1 Apr 60-15 Dec 61,
by Joseph S. Islinger. Feb 62, 75p
Contract AF33 616 7194, Proj. 1368, Task 13806
ASD TR-61-696

Unclassified report

Descriptors:(*Seals (Stoppers), Design), (*Spacecraft cabins, Seals (Stoppers)), Space environmental conditions, Vacuum, O-rings, Electrical conductance, Shafts, Elastomers, Manufacturing methods.

The report describes the development of near absolute sealing techniques for small openings, such as for electrical conductors, reciprocating and rotating shafts, and hatches in the walls of flight vehicle cabins. The need for absolute sealing stems from the requirement of a habitable environment in such vehicles for periods as long as one year under differential pressure and temperature extremes from -100 to +500F. The considerations underlying selection of suitable seal materials for resistance to the space environment, comprising radiation, high vacuum, temperature and static and dynamic loading, are discussed. The mechanical design and material factors considered conducive to and studies leading to a definition of absolute sealing are also discussed. Special investigations concerned with effect of elastomer permeability upon seal behavior and with techniques for adequately sealing electrical wires and cables were undertaken and are described. The developed seal concepts for each of the four sealing

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TECHNICAL LITERATURE SEARCHING SERVICE

The Clearinghouse for Federal Scientific and Technical Information has broadened its literature searching services in response to an increasing number of requests by industry and private research organizations for access to Government-held collections of scientific and technical literature. The collections include unclassified research reports on defense, atomic energy, space and other agency projects, as well as technical translations and information on Government-owned patents.

The service is operated by the Clearinghouse in cooperation with the Department of Agriculture, the Department of the Interior, and the Science and Technology Division of the Library of Congress. The program provides a fast and economical method by which a large segment of the public with special, often urgent, needs for research information can tap these four major Government literature resources. It offers "tailor-made" bibliographies suited to the day-to-day as well as long-range information requirements of scientists, engineers, and technical administrators. Steps are underway to make available under this program the literature resources and specialized information services of other Government agencies as well.

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FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

The Information Problem

The problem of managing effectively the enormous mass of information generated by greatly expanded R&D efforts in recent years has become acute. The United States alone is spending almost $20 billion each year on new R&D, two-thirds of it sponsored by the Federal Government. Not only is the volume of research information growing each year, but it is increasingly complex.

The Nation, and particularly the Federal Government, has a vital stake in making the most effective use of this information. For its part the Government is attempting to translate research information into a form that will ensure its most effective use and to streamline is dissemination to industry and the scientific and technical community.

The information problem has been of long-standing Congressional interest. It has been the subject of studies by the Committee on Government Operations, chaired by Senator John L. McClellan, and a subcommittee under Vice-President Hubert H. Humphrey, then Senator from Minnesota. Subsequently, White House task forces and the Federal Council for Science and Technology, a group consisting of senior policy officials concerned with agency science and technology programs, examined the Federal role.

In February 1964, the White House announced that the FCST had recommended that the Department of Commerce expand its "Clearinghouse" function, building upon the existing information services of the Office of Technical Services. Subsequently, the Clearinghouse for Federal Scientific and Technical Information was established.

The Clearinghouse is a national center for the dissemination of Government-generated information in the physical sciences and engineering, comparable to similar centers in agricultural and health research.

Commerce-Defense Agreement

In March of 1964, the Secretaries of Commerce and Defense signed an agreement whereby the Clearinghouse assumed the processing of unclassified documents produced by D.O.D. research and development laboratories and contractors. This joint venture has reinforced the expanded Clearinghouse activities, and has resulted in the elimination of duplicate processing and a reduction in cost of services both to the Department of Defense community and the general public.

Technical Information for Science and Industry

The Clearinghouse is a system for supplying the industrial and technical community with unclassified information about Government-generated science and technology in defense, space, atomic energy, and other national programs. It thus makes readily available, at low cost, research information which may aid in the development of a new product, solve a processing problem, or increase productivity through technical improvement.

The main services of the Clearinghouse are:

1. RESEARCH REPORTS. These consist of:
   - reports (more than 50,000 a year) based on federally sponsored R&D and
   - translations (about 25,000 a year) of foreign technical material.

After the documents are cataloged and indexed, they are put on sale in two forms, printed pages or microfiche—a 4″ x 6″ unitized sheet form of microphotography covering up to 70 pages.

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Selected documents are also announced through the technical, trade, and business press.

2. LITERATURE-SEARCHING SERVICE.

The Literature Searching Services provides two kinds of bibliographies:

a) "Current Awareness" bibliography for keeping subscribers abreast of new developments in their fields of interest on a periodic basis.

b) Retrospective bibliographic searches listing literature available on a subject at the time a request is made.

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3. GOVERNMENT-WIDE INDEX. Beginning in 1965, the Clearinghouse will issue a monthly consolidated index to the Government-sponsored technical literature. The Index will contain subject, author, source, and report number—the standard points of access to the total report literature. Such an Index will permit scientists, engineers, and research managers to scan one publication in reviewing report literature in their fields of interest.

4. REFERRAL SERVICES. The Clearinghouse is setting up a master file of sources of information in the physical sciences and engineering. These sources include both Government-sponsored centers and private industry. Inquirers are referred to the sources most likely to have the information needed on a given subject. The Clearinghouse cooperates with the National Referral Center (Library of Congress) in providing the service.

5. RESEARCH IN PROGRESS. The Clearinghouse will be the single point of contact for information on current Government-supported unclassified research and development work in progress. The aim is to help the industrial and technical community avoid duplication of technical work by announcing who is doing what in the unclassified area of Government research. The Science Information Exchange (Smithsonian Institution) will cooperate in this effort. The SIE and other agencies will notify the Clearinghouse of new research projects. This information will then be cataloged and made available. The service will offer listings by project, title, performing organization, principal investigators, term of contract or grant, and descriptive terms for the new research reported. The file created through input of current research will also be used in general Clearinghouse reference services to answer inquiries in specific areas.

6. SELECTIVE BIBLIOGRAPHIES—Bibliographies are also compiled in many areas of broad interest, such as plastics, welding, transistors, lasers, etc. By writing to the Clearinghouse for Federal Scientific and Technical Information, a free list of these bibliographies can be obtained.

7. REGIONAL DISSEMINATION. Technical information contained in selected Government research reports is examined, reviewed, and is "packaged" for industry's use. The resulting packages are distributed to local groups, such as universities, technical assistance organizations, state and regional economic agencies, professional technical consultants, and others. The packages consist of selected abstracts, indexes, literature reviews, and other information aimed at specific industrial needs—e.g. metal working, textiles, chemical processing. The packages sell for 50 cents each.

Some of the Benefits of the Clearinghouse Services:

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- Ideas for new technology from Government-owned patents—abstracts of these patents are published by the Clearinghouse and the patents may be licensed free for your own use.

Some future services in the planning stage at the Clearinghouse are:

- Subscription sales of Federal research reports by industrial categories
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Abrasives, grinding and polishing materials. Sept. 1955. 63 refs. CTR-309
Acceleration and Weightlessness (Biological Aspects). Sept. 1963. 268 refs. SB-520.
Adhesives. Sept. 1956. 478 refs. CTR-300
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Agriculture, Food, Fishes, Forestry. Pt.I: PL-480 Translation Program. Feb. 1964. 301 refs. SB-530.
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Aromatic compounds. (In: Organic catalysts, Pt. II). Aug. 1962. SB-506.
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Expanded plastics. Nov. 1963. 175 refs. SB-524.
Explosive metal forming. Dec. 1961. 66 refs. SB-441 Rev.
Explosive metal forming. Supplement to SB-441 Rev. SB-441 Rev. Suppl.1. IN PROCESS.
Extrusion, Rolling, Drawing (Metalworking, Part IV) Apr. 1961. 254 refs. SB-463.

Fabrics, Textile. Sept. 1961. 401 refs. SB-481.
Fabrics, Textile. Supplement to SB-481. Dec. 1964. 432 refs. SB-481 Suppl.1.
Ferroelectricity and ferromagnetism. Sept. 1960. 330 refs. SB-434.
Fertilizers. Sept. 1963. 348 refs. SB-522.
Fiber glass and glass laminates. 1958. 206 refs. CTR-292.
Fiber glass and glass laminates. Supplement to CTR-292. Sept. 1961. 120 refs. SB-479.
Fiber glass and glass laminates. Supplement to SB-479. SB-479 Suppl.1. IN PROCESS.
Fiber reinforced metals. (In: Metal composites. 1964. SB-526).
Fibers, Textile, Sept. 1961. 347 refs. SB-480.
Fibers, Textile. Supplement to SB-480. Dec. 1964. 364 refs. SB-480 Suppl.1.
Filament wound construction. 1964. 115 refs. SB-527.
Fishes. (In: Agriculture, Food, Fishes, Forestry. Feb. 1964. SB-530.)
Fluid amplifiers. Feb. 1965. 32 refs. SB-541.
Fluorides. Feb. 1962. 196 refs. SB-492.
Fluorine and fluorine compounds. 1962. 243 refs. SB-491.
Fluorocarbons. 1962. 97 refs. SB-493.
Foamed materials (In: Expanded plastics. SB-524).
Food. (In: Agriculture, Food, Fishes, Forestry. Feb. 1964. SB-530).
Food preservation (except by irradiation) May 1960. 125 refs. SB-412.
Food preservation (except by irradiation) May 1962. 91 refs. SB-412 Suppl.1.
Food preservation (except by irradiation). Supplement to SB-412 Suppl.1. SB-412 Suppl.2. IN PROCESS.
Food preservation by irradiation. May 1962. 185 refs. SB-403 Rev.
Food preservation by irradiation. Supplement to SB-403 Rev. SB-403 Suppl.1, Rev. IN PROCESS.
Forestry. (In: Agriculture, Food, Fishes, Forestry. Feb. 1964. SB-530).
Forging, and Casting (Metalworking, Part III) Apr. 1961. 431 refs. SB-462.
Fuel Cells. Aug. 1963. 218 refs. SB-447 Rev.
Fused salts. Aug. 1960. 135 refs. SB-425.
Gallium, Indium, Selenium, Tellurium, Antimony, Bismuth Sept. 1960. 266 refs. SB-438.
Geriatrics. (In: Aging (Physiology) Dec. 1963. SB-528).
Germanium and Silicon. Sept. 1960. 360 refs. SB-437.
Gerontology. (In: Aging (Physiology). Dec. 1963. SB-528.)
Glass. April 1959. 198 refs. CTR-370.
Glass. Supplement to CTR-370. Aug. 1961. 292 refs. SB-478.
Glass. Supplement to SB-478. SB-478 Suppl.1. IN PROCESS.

Glass laminates and Fiber glass. Nov. 1958. 206 refs. CTR-292.
Glass laminates and Fiber glass. Supplement to CTR-292. Sept. 1961. 120 refs. SB-479.
Glass laminates and Fiber Glass. Supplement to SB-479. SB-479 Suppl.1. IN PROCESS.
Greases and Lubricants. June 1958. 95 refs. CTR-345.
Greases, Hydraulic fluids, Lubricants. Supplement to CTR-21, CTR-345. May 1961. 328 refs. SB-459.

Heat exchangers, and Heat transfer. Feb. 1961. 591 refs. SB-450.
Heat resistant alloys, and High temperature metallurgy. Feb. 1961. 674 refs. SB-452.
Heat transfer and heat exchangers. Feb. 1961. 591 refs. SB-450.
Heat treatment of metals. Feb. 1961. 210 refs. SB-454.
Hides, Shoes, Leather. Oct. 1961. 100 refs. SB-483.
High temperature research (ceramics, gases, lubricants, plastics, electrical and electronic equipment) Feb. 1961. 473 refs. SB-453.
High temperature metallurgy and Heat resistant alloys. Feb. 1961. 674 refs. SB-452.
Honeycomb cores. (In: Sandwich construction. SB-517)
Human Engineering; Part I: Psychological and psychiatric research and tests. Oct. 1958. 369 refs. CTR-358.
Human Engineering; Part II: Group behavior and leadership. Oct. 1958. 140 refs. CTR-359.
Human Engineering; Part III: Personnel training. Oct. 1958. 434 refs. CTR-360.
Human Engineering; Part IV: Aptitude testing, Oct. 1958. 311 refs. CTR-361.
Human Engineering; Part V: Auditory and visual research and tests. Oct. 1958. 273 refs. CTR-362.
Human Engineering; Part VI: Personnel training aids and devices. Oct. 1958. 247 refs. CTR-363.
Human Engineering (Computer research) Aug. 1961. 137 refs. SB-473.
Hydraulic fluids, Lubricants, Greases. May 1961. 328 refs. SB-459.
Hydrofoil boats. Dec. 1963. 58 refs. SB-529.

Indium, Selenium, Tellurium, Antimony, Bismuth, Gallium. Sept. 1960. 266 refs. SB-438.
Industrial Diamonds. Dec. 1962. 120 refs. SB-512.
Information storage and retrieval. Oct. 1961. 170 refs. SB-475.
Information storage and retrieval. April 1963. 302 refs. SB-475 Suppl.1.
Information storage and retrieval. Supplement to SB-475 Suppl.1. SB-475 Suppl.2. IN PROCESS.
Infrared; Part I: General research, equipment and materials. 380 refs. SB-466.
Infrared; Part II: Infrared spectroscopy. June 1961. 180 refs. SB-467.
Inorganic catalysts. Aug. 1962. 206 refs. SB-508.
Insect control and Insecticides (included in: Pest Control) Sept. 1962. 615 refs. SB-486.
Integrated Master Programming and Scheduling (IMPS) (In: Management Planning and Control Techniques. Jan. 1963. SB-510).
Irasers (Included in: Masers and lasers. July 1962. SB-488).
Irasers (included in: Masers and lasers) Aug. 1963. SB-488 Suppl.1
Irradiation, Food preservation by. May 1962. 187 refs. SB-403 Rev.
Irradiation, Food preservation by. 1965. SB-403 Suppl.1 Rev. IN PROCESS.

Japanese science and technology. May 1961. 703 refs. SB-477.
Japanese science and technology. Aug. 1963. 1164 refs. SB-477 Suppl.1.

Laminates, Glass. Nov. 1958. 206 refs. CTR-292.
Laminates, Glass. Supplement to CTR-292. Sept. 1961. 120 refs. SB-479.
Laminates, Plastic (Non-glass fiber type). Apr. 1956. 61 refs. CTR-320.
Lamps. Aug. 1958. 207 refs. CTR-354.
Lasers and masers. July 1962. 208 refs. SB-488.
Lasers and masers. Aug. 1963. 203 refs. SB-488 Suppl.1.
Learning machines. (In: Computer research. Aug. 1961. SB-473).
Learning machines. (In: Computer related research. Feb. 1963. SB-473 Suppl.1.)
Least Cost Estimating and Scheduling (LESS). (In: Management Planning and Control Techniques. Jan. 1963. 42 refs. SB-510).
Leather, Hides, and Shoes. Oct. 1961. 100 refs. SB-483.
Lenses, and Optics, Part I. Aug. 1958. 426 refs. CTR-355.
Lenses, and Optics, Part II. Aug. 1958. 358 refs. CTR-356.
Linear programming. June 1963. 141 refs. SB-407 Rev.
Liquid metals. Aug. 1960. 179 refs. SB-424.
Lithium, Cesium Rubidium, Sodium, Potassium (alkali metals). July 1960. 672 refs. SB-421.
Longevity. (In: Aging (Physiology) Dec. 1963. SB-528).
Low temperature research on materials. Feb. 1961. 316 refs. SB-451.
Lubricants additives. Sept. 1956. 62 refs. CTR-322.
Lubricants and Greases. June 1958. 95 refs. CTR-345.
Lubricants, Greases and Hydraulic fluids. Supplements CTR-21, -322, -345. May 1961. 328 refs. SB-459.
Lubricants, Synthetic. Oct. 1957. 142 refs. CTR-21.

Machine and Cutting Tools (Metalworking, Part II). Apr. 1961. 336 refs. SB-461.
Machine and Cutting Tools (Metalworking, Part II). Supplement to SB-461. Feb. 1962. 191 refs. SB-490.
Machine translation. Apr. 1963. 252 refs. SB-470 Rev.
Machining (Metalworking, Part I). Apr. 1961. 357 refs. SB-460.
Magnesium, Nov. 1960. 442 refs. SB-445.
Magnetic amplifiers. Nov. 1955. 39 refs. CTR-244.
Magnetic recording. Mar. 1963. 190 refs. SB-471 Rev.
Magnetohydrodynamics. Aug. 1960. 122 refs. SB-426.
Magnetohydrodynamics. Jan. 1962. 185 refs. SB-426, Suppl.1.
Magnetostriction. Aug. 1960. 59 refs. SB-427.
Management Planning and Control Techniques. Jan. 1963, 42 refs. SB-510.
Masers and Lasers. July 1962. 208 refs. SB-488.
Masers and Lasers. Aug. 1963. 203 refs. SB-488 Suppl.1.
Materials Handling, Storage, Containers, Packaging, Nov. 1961. 400 refs. SB-476.
Materials Handling, Storage, Containers, Packaging, Supplement to SB-476. SB-476 Suppl.1. IN PROCESS.
Materials testing. May 1960. 248 refs. SB-411.
Materials testing. Supplement to SB-411. Nov. 1963. 379 refs. SB-411 Suppl.1.
Matrix algebra - Applications. Dec. 1961. 100 refs. SB-485.
Medicine, Space. Nov. 1963. 240 refs. SB-519.
Metal coatings. May 1960. 441 refs. SB-409.
Metal coatings. 1963. 671 refs. SB-409 Suppl.1.
Metal composites. (Includes fiber reinforced metals and whisker-reinforced metals). 1964. 72 refs. SB-526.
Metal forming, Explosive. Dec. 1961. 66 refs. SB-441 Rev.
Metallurgy, High temperature, and Heat resistant alloys, Feb. 1961. 674 refs. SB-452.
Metals, Heat treatment of. Feb. 1961. 210 refs. SB-454.
Metals, Platinum and Allied. July 1960. 118 refs. SB-420.
Metals, Platinum and Allied. Supplement to SB-420. SB-420 Suppl.1 IN PROCESS.
Metals, Whisker-reinforced. (In: Metal composites SB-526).
Metalworking; Part I: Machining. Apr. 1961. 357 refs. SB-460.
Metalworking; Part II: Machine and cutting tools. Apr. 1961. 336 refs. SB-461.
Metalworking; Part II: Machine and cutting tools. Supplement to SB-461. Feb. 1962. 191 refs. SB-490.
Metalworking; Part III: Casting and Forging. Apr. 1961. 431 refs. SB-462.

Metalworking; Part IV: Rolling, Drawing and Extrusion. Apr. 1961. 254 refs. SB-463.
Miniaturization, Electronic. Jan. 1958. 117 refs. CTR-250.
Miniaturization Electronic. Supplement to CTR-250. Dec. 1961. 158 refs. SB-444.
Molten and fused salts. Aug. 1960. 135 refs. SB-425.
Molybdenum and tungsten. June 1960. 390 refs. SB-415.
Molybdenum and tungsten. Supplement to SB-415. SB-415 Suppl. 1. IN PROCESS.

Nickel. May 1961. 456 refs. SB-465.
Non-destructive testing (In: Materials testing. May 1960. 248 refs. SB-411).
Non-destructive testing. (In: Materials testing. SB-411 Suppl.1).
Numerical Controlled Tool Systems. 1965. SB-544. IN PROCESS.

Oceanography. July 1962. 371 refs. SB-497.
Optics and lenses; Part I. Aug. 1958. 426 refs. CTR-355.
Optics and lenses; Part II. Aug. 1958. 358 refs. CTR-356.
Organic catalysts. Pt. I: Aliphatic compounds and Petroleum products. Aug. 1962. 266 refs. SB-505.
Organic catalysts. Pt. II: Aromatic compounds and General concepts and theory. Aug. 1962. 180 refs. SB-506.
Organic catalysts. Pt. III. Organic polymers. Aug. 1962. 181 refs. SB-507.
Organic polymers (organic catalysts, pt. III) Aug. 1962. 181 refs. SB-507.
Oxygen steel making - foreign literature. Feb. 1962. 115 refs. SB-489.
Ozone. Aug. 1962. 169 refs. SB-509.

Packaging, Materials handling, Storage, Containers, Nov. 1961. 490 refs. SB-476.
Packaging, Material handling, Storage, Containers. Supplement to SB-476. SB-476 Suppl.1. IN PROCESS
Paints and Varnishes. 1963. 398 refs. SB-518.
Paper. July 1963. 558 refs. SB-515.
Paper capacitors. July 1963. 56 refs. SB-516.
Parasitology. Apr. 1962. 372 refs. SB-495.
Parasitology, Parasites, and Parasitic Infections. July 1963. 320 refs. SB-495 Suppl.1.
Performance standards (In: Engineered performance standards U.S. Navy Bureau of Yards & Docks. April 1964. SB-514 Rev.).
PERT. (In: Management Planning & Control Techniques. Jan 1963. SB-510).
Pest Control. (including Pesticides; Insect control and Insecticides; Rodent control and Rodenticides) Sept. 1962. 615 refs. SB-486.
Petroleum products. (In: Organic catalysts, Pt. I. Aug. 1962. SB-505).
Photochemistry and photoelectricity. (excluding photography). June 1955. 158 refs. CTR-311.
Photogrammetry. Jan. 1958. 187 refs. CTR-335.
Photogrammetry. Supplement to CTR-335. May 1960. 92 refs. SB-416.
Photogrammetry. Supplement to SB-416. SB-416 Suppl.1 IN PROCESS
Photographic accessories, and Cameras. Aug. 1958. 469 refs. CTR-353.
Photographic chemicals and emulsions. June 1960. 112 refs. SB-417.
Photography. Aug. 1958. 527 refs. CTR-352.
Plastics, Expanded. Nov. 1963. 175 refs. SB-524.
Plastics-polymer research. Oct. 1959. 504 refs. SB-400.
Plating. (In: Metal Coatings. Aug. 1963. SB-409 Suppl.1).
Platinum and allied metals. July 1960. 118 refs. SB-420.
Platinum and allied metals. Supplement to SB-420. SB-420 Suppl.1. IN PROCESS.
Polyethylene. Nov. 1957. 66 refs. CTR-332.
Polymers, Organic (Organic catalysts, pt. III). Aug. 1962. 181 refs. SB-507.
Polymer research (plastics) Oct. 1959. 504 refs. SB-400.
Polystyrene. June 1958. 139 refs. CTR-346.
Potassium, Lithium, Cesium, Rubidium, Sodium (alkali metals) July 1960. 672 refs. SB-421.
Powder metallurgy. May 1958. 360 refs. CTR-343.
Powder metallurgy. Supplement to CTR-343. Aug.1960. 103 refs. SB-423.
Power Sources, Unconventional. Feb. 1962. 427 refs. SB-484.
Printed electronic circuits. July 1962. 147 refs. SB-496.
Program Evaluation Procedure (PEP) (In: Management Planning & Control Techniques. Jan. 1963. SB-510)
Program Evaluation and Review Technique (PERT) (In: Management Planning & Control Techniques. Jan. 1963. SB-510.
Programming and Data processing. Sept. 1961. 373 refs SB-474.
Programming and Data processing. Feb. 1963. 1001 refs. SB-474 Suppl.1.
Propellants. Feb. 1958. 146 refs. CTR-338.
Protective clothing and other apparel. Oct. 1961. 154 refs. SB-482.
Protective clothing and other apparel. Supplement to SB-482. Nov. 1964. 196 refs. SB-482 Suppl.1
Protective shelters. July 1961. 116 refs. SB-469.

Quality control, Reliability. Sept. 1962. 755 refs. SB-405 Rev.
Quartermaster Corps textile series reports. Nov. 1960. 104 refs. SB-440.
Quartermaster Corps textile series reports. Supplement to SB-440. Nov. 1964. 15 refs. SB-440 Suppl.1.

Radioprotective Agents. Feb. 1963. 94 refs. SB-511.
Rare earth elements. Mar. 1960. 533 refs. SB-404.
Reading machines. (In: Computer research. Aug. 1961. 137 refs. SB-473.)
Reading machines. (In: Computer related research. Feb. 1963. 369 refs. SB-473 Suppl.1)
Recording, Magnetic. Mar. 1963. 190 refs. SB-471 Rev.
Rectifiers. Jan. 1958. 402 refs. CTR-337.
Refractories and Ceramics. July 1959. 569 refs. CTR-373.
Reliability and quality control. Sept. 1962. 755 refs. SB-405 Rev.
Resistors and Thermistors. Aug. 1960. 118 refs. SB-429.
Rodent control and Rodenticides. (In: Pest Control Sept. 1962. SB-486).
Rolling, Drawing and Extrusion (Metalworking, Part IV). Apr. 1961. 254 refs. SB-463.
Rubber. June 1956. Supplement. Aug. 1957. 242 refs. CTR-321.
Rubber. Supplement to CTR-321. Feb. 1962. 455 refs. SB-494.
Rubidium, Sodium, Potassium, Lithium, Cesium (alkali metals) July 1960. 672. SB-421.

Saline Water (Desalination of Water. July 1962. 131 refs. SB-419 Rev.)
Saline Water (Desalination of Water. Supplement to SB-419 Rev. SB-419 Rev. Suppl.1). IN PROCESS
Salts, Molten and Fused. Aug. 1960. 135 refs. SB-425.
Sandwich construction. Supersedes CTR-318. Sept. 1963. 320 refs. SB-517.
Scheduling and Control by Automated Network Systems (SCANS) (In: Management Planning & Control Techniques. Jan. 1963. 42 refs.) SB-510.
Science and Technolocay. Pt. IV: PL-480 Translation Program. Feb. 1964. 322 refs. SB-533.
Sea water batteries. (In: Unconventional power sources. SB-484).
Selenium, Tellurium, Antimony, Bismuth, Gallium, Indium, Sept. 1960. 266 refs. SB-438.
Semiconductors. Apr. 1958. 80 refs. CTR-340.
Semiconductors. Supplement to CTR-340. Sept. 1960. 314 refs. SB-435.
Semiconductors. Supplement to SB-453. SB-435 Suppl.1. IN PROCESS.
Servomechanisms and Control systems. Aug. 1962. 364 refs. SB-499.

Shelters, Protective. July 1961. 116 refs. SB-469.
Shoes, Leather, Hides. Oct. 1961. 100 refs. SB-483.
Silicon, Germanium. Sept. 1960. 360 refs. SB-437.
Soaps and Detergents. Nov. 1957. 323 refs. CTR-333.
Soaps, Detergents, Cleaning Agents. Supplement to CTR-333. July 1961. 88 refs. SB-468.
Sodium, Potassium, Lithium, Cesium, Rubidium (alkali metals) July 1960. 672 refs. SB-421.
Solar energy applications. July 1960. 68 refs. SB-418.
Solar energy applications. Jan. 1962. 110 refs. SB-418, Suppl.1.
Space Environmental Conditions-Biological Aspects. Sept. 1963. 176 refs. SB-521.
Space medicine. Nov. 1963. 240 refs. SB-519.
Spectroscopy, Infrared. June 1961. 180 refs. SB-467.
Speech, Intelligibility of. Oct. 1958. 140 refs. CTR-45.
Steel making (Oxygen) - foreign literature. Feb. 1962. 115 refs. SB-489.
Stereoscopy. Apr. 1958. 175 refs. CTR-341.
Stimulants, Tranquilizers. Apr. 1961. 87 refs. SB-443.
Storage, Containers, Packaging, Materials handling. Supplement to CTR-72. Nov. 1961. 490 refs. SB-476.
Storage, Containers, Packaging, Materials handling. Supplement to SB-476. SB-476 Suppl.1. IN PROCESS.
Stroboscopy. Apr. 1958. 21 refs. CTR-339.
Strontium, Barium, Calcium (alkaline earth elements.) July 1960. 335 refs. SB-422.

Tantalum, Columbium. June 1960. 237 refs. SB-414.
Tantalum, Columbium. Supplement to SB-414. SB-414 Suppl.1. IN PROCESS.
Teaching Machines. (In: Computer research. SB-1963. SB-473 Suppl.1)
Technical and Foreign Language Dictionaries. SB-542. IN PROGESS.
Technology and science. Pt. IV: PL-480 Translation Program. Feb. 1964. 322 refs. SB-533.
Tellurium, Antimony, Bismuth, Gallium, Indium, Selenium. Sept. 1960. 266 refs. SB-438
Testing, Materials, May 1960. 248 refs. SB-411.
Testing, Materials. Supplement to SB-411. Nov. 1963. 379 refs. SB-411 Suppl.1.
Testing, Non-destructive. (In: Materials testing. May 1960. SB-411).
Testing, Non-destructive. (In: Materials testing. 1963. SB-411 Suppl.1)
Textile fabrics and related research. Sept. 1961. 401 refs. SB-481.
Textile fabrics and related research. Supplement to SB-481. Dec. 1964. 432 refs. SB-481, Suppl.1
Textile fibers. Sept. 1961. 347 refs. SB-480.
Textile fibers. Supplement to SB-480. Dec. 1964. 364 refs. SB-480 Suppl.1.
Textile series reports. Quartermaster Corps. Nov. 1960. 104 refs. SB-440.
Textile series reports. Quartermaster Corps. Supplement to SB-440. Nov. 1964. 15 refs. SB-440 Suppl.1.
Thermionics and cathodes. Aug. 1960. 157 refs. SB-431.
Thermistors and resistors. Aug. 1960. 118 refs. SB-429.
Thermocouples and Thermopiles. Aug. 1960. 93 refs. SB-430.
Thermoelectricity. Sept. 1960. 117 refs. SB-432.
Thermoelectricity. Jan. 1962. 116 refs. SB-432, Suppl.1.
Thermopiles and thermocouples. Aug. 1960. 93 refs. SB-430.
Titanium; Part I; Metals and Alloys. July 1958, 433 refs. CTR-349. See also SB-534.
Titanium; Part II; Carbides and compounds. July 1958. 210 refs. CTR-350. See also SB-535.
Titanium; Part III; Barium titanate. July 1958. 68 refs. CTR-351. See also SB-536.
Titanium carbides and compounds. Supplement to CTR-350. March 1964. 456 refs. SB-535.
Titanium metals and alloys. Supplement to CTR-349. March 1964. 1044 refs. SB-534.
TOPS (The Operational Pert System) (In: Management Planning & Control Techniques. Jan. 1963. 42 refs.) SB-510.
Tranquilizers and Stimulants. Apr. 1961. 87 refs. SB-443.
Transducers. Aug. 1960. 92 refs. SB-428.
Transducers. July 1962. 166 refs. SB-428 Suppl.1.
Transformers. Jan. 1958. 215 refs. CTR-336.
Transformers. (Suppl. to CTR-336) July 1962. 115 refs. SB-487.
Transistors. June 1959. 146 refs. CTR-310.
Transistors. (Supplement to CTR-310) Aug. 1960. 201 refs. SB-433.
Transistors. Aug. 1962. 391 refs. SB-433 Suppl.1.
Translation, Machine. Apr. 1963. 252 refs. SB-470 Rev.
Translations under PL-480 Program. Feb. 1964.
Pt.1: Agriculture, Food, Fishes, Forestry. SB-530.
Pt.2: Biological sciences. SB-531.
Pt.3: Earth sciences. SB-532.
Pt.4: Science and Technology. SB-533.
Tungsten, Molybdenum, June 1960. 390 refs. SB-415.
Tungsten, Molybdenum. Supplement to SB-415. SB-415 Suppl.1. IN PROCESS.

Ultrasonics. Nov. 1957. 186 refs. CTR-288.
Ultrasonics. (Suppl. to CTR-288) Sept. 1962. 524 refs. SB-500.
Ultrasonics in Medicine and Biology. (In: Ultrasonics. Sept. 1962). SB-500.
Unconventional power sources. Feb. 1962. 427 refs. SB-484.
Uranium, Part I - General. July 1958. 439 refs. CTR-365.
Uranium, Part II - Alloys and compounds. July 1958. 397 refs. CTR-366.

Varnishes and Paints. 1963. 398 refs. SB-518.
Vibration. June 1961. 365 refs. SB-436.

Water, Desalination of. July 1962. 131 refs. SB-419, Rev.
Water, Desalination of. Supplement to SB-419 Rev. SB-419 Rev. Suppl.1. IN PROCESS.
Water pollution and Water purification. July 1962. 179 refs. SB-498.
Weightlessness and Acceleration (Biological Aspects) Sept. 1963. 268 refs. SB-520.
Welding; Part I: Steel and ferrous alloys. Feb. 1957. 235 refs. CTR-324.
Welding; Part II: Aluminum and magnesium. Feb. 1957. 116 refs. CTR-325.
Welding; Part III: Miscellaneous metals. Feb. 1957. 65 refs. CTR-326.
Welding; Part V: Resistance welding. Feb. 1957. 62 refs. CTR-328.
Welding; Part VI: Gas welding. Feb. 1957. 51 refs. CTR-329.
Welding; Part VII: Electrodes and equipment. Feb. 1957. 103 refs. CTR-330.
Welding; Part VIII: General welding methods. Feb. 1957. 95 refs. CTR-331.
Welding. Supplement to CTR's 324-331. Jan. 1963. 783 refs. SB-402 Rev.
Whisker - reinforced metals. (In: Metal composites. 1964. SB-526.)
Wood. Apr. 1960. 276 refs. SB-408.

Zirconium. June 1958. 375 refs. CTR-344.
Zirconium. (Supplement to CTR-344) May 1961. 362 refs. SB-464.

SB-400 Plastics-polymer research (Five year bibliography). 1959. 504 refs.
SB-401 Corrosion (Ten year bibliography). 1959. 1004 refs.
SB-401 Supl.1 Corrosion. 1963. 928 refs.
SB-402 Rev. Welding (Supplement to CTR's 324-331). 1963. 783 refs.
SB-403 Rev. Food preservation by irradiation. 1962. 185 refs. (See also SB-412 and Sup.1).
SB-403 Sup.1 Rev. Food preservation by irradiation. 1965. IN PROCESS.
SB-404 Rare earth elements (1940-1960). 533 refs.
SB-405 Rev. Reliability and quality control. 1962. 748 refs.
SB-406 Adhesives (Supplement to CTR-300). 1960. 98 refs.
SB-407 Rev. Linear programming. 1963. 141 refs.
SB-408 Wood (1950-1960) 1960. 276 refs.
SB-409 Metal coatings (1950-1960) 1960. 441 refs.
SB-409 Sup.1 Metal coatings. 1963. 671 refs.
SB-410 Bearings. 1945-1960. 1960. 294 refs. (See also CTR-290).
SB-410 Sup.1 Bearings. 1963. 379 refs.
SB-411 Materials testing (1950-1960) 1960. 248 refs.
SB-411 Sup.1 Materials testing (Includes non-destructive testing). 1963. 376 refs.
SB-412 Food preservation (Except by irradiation) (1950-1960). 125 refs.
SB-412 Sup.1 Food preservation (Except by irradiation) 1962. 91 refs.
SB-412 Sup.2 Food preservation (Except by irradiation). 1963. IN PROCESS.
SB-413 Beryllium (1945-1960). 1960. 362 refs.
SB-413 Sup.1 Beryllium. 1965. IN PROCESS.
SB-414 Columbium and Tantalum. 1960. 237 refs.
SB-414 Sup.1 Columbium and Tantalum. 1965. IN PROCESS.
SB-415 Molybdenum and Tungsten. 1960. 390 refs.
SB-415 Sup.1 Molybdenum and Tungsten. 1965. IN PROCESS.
SB-416 Photogrammetry (Supplement to CTR-335). 1960. 92 refs.
SB-416 Sup.1 Photogrammetry. 1965. IN PROCESS.
SB-417 Photographic chemicals and emulsions. 1960. 112 refs.
SB-418 Solar energy applications. 1960. 68 refs.
SB-418 Sup.1 Solar energy applications. 1962. 110 refs.
SB-419 Rev. Desalination of water. 1962. 131 refs.
SB-419 Rev. Sup.1 Deslaination of water. 1965. IN PROCESS
SB-420 Platinum and allied metals. 1960. 118 refs.
SB-420 Sup.1 Platinum and allied metals. 1965. IN PROCESS.
SB-421 Alkali metals; lithium, sodium, potassium, rubidium and cesium. 1960. 672 refs.
SB-422 Alkaline earth elements (Barium, calcium and strontium). 1960. 335 refs.
SB-423 Powder metallurgy (Supplement to CTR-343). 1960. 103 refs.
SB-424 Liquid metals. 1960. 179 refs.
SB-425 Molten and fused salts. 1960. 135 refs.
SB-426 Magnetohydrodynamics. 1960. 122 refs.
SB-426 Sup.1 Magnetohydrodynamics. 1962. 185 refs.
SB-427 Magnetostriction. 1960. 59 refs.
SB-428 Transducers. 1960. 92 refs.
SB-428 Sup.1 Transducers. 1962. 166 refs.
SB-429 Thermistors and Resistors. 1960. 118 refs.
SB-430 Thermopiles and Thermocouples. 1960. 93 refs.
SB-431 Thermionics and Cathodes. 1960. 157 refs.
SB-432 Thermoelectricity. 1960. 117 refs.
SB-432 Sup.1 Thermoelectricty. 1962. 116 refs.
SB-433 Transistors (Supplement to CTR-310). 1960. 201 refs.
SB-433 Sup.1 Transistors. 1962. 391 ref.
SB-434 Ferroelectricty and ferromagnetism. 1960. 330 refs.
SB-435 Semiconductors (Supplement to CTR-340). 1960. 314 refs.
SB-435 Sup.1 Semiconductors. 1965. IN PROCESS.
SB-436 Vibration. 1961. 365 refs.
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SB-438 Antimony, bismuth, gallium, indium, selenium and tellurium. 1960. 266 refs.
SB-439 Machine translation. 1960. 46 refs. Supplemented by SB-470 Rev.
SB-440 Quartermaster corps textile series reports (1942-1960). 1960.
SB-440 Sup.1 Quartermaster corps textile series reports. Nov. 1964. 15 refs.
SB-441 Rev. Explosive metal forming. 1961. 66 refs.
SB-441 Rev. Sup.1 Explosive metal forming. 1965. IN PROCESS.
SB-442 Chinese maninland science and technology. 1961. 380 refs.
SB-442 Sup.1 Chinese mainland science and technology. 1963. 555 refs.
SB-443 Tranquilizers and stimulants. 1961. 87 refs.
SB-444 Electronic miniaturization. (Supplement to CTR-250). 1961. 158 refs.
SB-445 Magnesium 1960. 442 refs.
SB-446 Biological sciences. 1961. 88 refs.
SB-447 Rev. 2 Fuel cells and related research. 1963. 204 refs.
SB-448 Rev. Air pollution and purification. 1963. 360 refs.
SB-448 Rev. Sup.1 Air Pollution and Purification. 1965. IN PROCESS.
SB-449 Cooling and coolants for electrical and electronic equipment, turbines and reactors. 1961. 263 refs.
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SB-451 Low temperature research on materials. 1961. 316 refs.
SB-452 High temperature metallurgy and heat resistant alloys. 1961. 674 refs.
SB-453 High temperature research (Ceramics, gases, lubricants, plastics, electrical and electronic equipment, etc.) 1961. 473 refs.
SB-454 Heat treatment of metals. 1961. 210 refs.
SB-455 Rev. Bio-Astronautics. 1963. 433 refs.
SB-456 Boron and its compounds (Supplement to CTR-303). 1961. 465 refs.
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SB-458 Copper. 1961. 465 refs.
SB-459 Lubricants, greases and hydraulic fluids. 1961. 328 refs.
SB-460 Metalworking. Part I: Machining. 1961. 357 refs.
SB-461 Metalworking. Part II: Machine and Cutting Tools. 1961. 336 refs. Supplemented by SB-490.
SB-462 Metalworking. Part III: Casting and Forging. 1961. 431 refs.
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SB-467 Infrared, Part II: Infrared Spectroscopy. 1961. 188 refs.

SB-468 Soaps, detergents, cleaning agents. (Supplement to CTR-333) 1961. 88 refs.

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SB-472 Computers (Supplement to CTR-371). 1961. 463 refs.

SB-472 Sup.1 Computers. 1963. 808 refs.

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SB-473 Sup.1 Computer related research. 1963. 369 refs.

SB-474 Data processing and programming. 1961. 373 refs.

SB-474 Sup.1 Data processing and programming. 1963. 1001 refs.

SB-475 Information storage and retrieval. 1961. 170 refs.

SB-475 Sup.1 Information storage and retrieval. 1963. 302 refs.

SB-475 Sup.2 Information storage and retrieval. 1965. IN PROCESS.

SB-476 Containers, packaging, materials handling and storage. 1961. 490 refs. Supplements CTR-72.

SB-476 Sup.1 **Containers, packaging**, materials **handling and storage.** 1965. IN PROCESS.

SB-477 Japanese science and technology. 1962. 703 refs.

SB-477 Sup.1 Japanese science and technology. 1963. 1164 refs.

SB-478 Glass (Supplement to CTR-370). 1961. 292 refs.

SB-478 Sup.1 Glass. 1965. IN PROCESS.

SB-479 Fiber glass and glass laminates (Supplement to CTR-292). 1961. 120 refs. (See also: CTR-370 and SB-478).

SB-479 Sup.1 Fiber glass. 1965. IN PROCESS.

SB-480 Textile fibers. 1961. 347 refs. (See also: SB-440 and SB-481).

SB-480 Sup.1 Textile fibers. Dec. 1964. 364 refs.

SB-481 Textile fabrics and related research. 1961. 401 refs. (See also SB-440 and SB-480). 154 refs.

SB-481 Sup.1 Textile fabrics and related research. Dec. 1964. 432 refs. (See also SB-440 and Supp.1, SB-480 and Suppl.1).

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SB-532 Earth sciences. Pt.3: PL-480. Translation Program. Feb. 1964. 113 refs.

SB-533 Science and technology. Pt. 4: PL-480 Translation Program. Feb. 1964. 322 refs.

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SB-535 Titanium carbides and compounds. Supplement to CTR-350. March 1964. 456 refs.

SB-536 Barium titanate. Supplement to CTR-351. March 1964. 108 refs.

SB-537 Crystals, Part I: Metallic and single crystals. (Supplement to CTR-367). 1965. IN PROCESS.

SB-538 Crystals, Part II: Lattices and structure. 1965. (Supplement to CTR-368). IN PROCESS.

SB-539 Crystals, Part III: Quartz and other piezoelectric crystals. Supplement to CTR-369. 1965. IN PROCESS.

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SB-541 Fluid Amplifiers. Feb. 1965. 32 refs.

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SB-543 Numerical Controlled Tool Systems. 1965. IN PROCESS.

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CTR-244 Magnetic amplifiers. 1940-55. Rev. 1955. 39 refs.

CTR-250 Electronic miniaturization. 1944-58. Rev. 1958. 117 refs. Supplemented by SB-444.

CTR-288 Ultrasonics. 1932-57. Rev. 1957. 186 refs. Supplemented by SB-500.

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CTR-370 Glass. 1930-58. 1959. 198 refs. Supplemented by SB-478. (See also CTR-292).

CTR-371 Computers. 1937-58. 1959. 495 refs. Supplemented by SB-472 and Sup.1. (See also SB-473 and Sup.1.)

CTR-373 Ceramics and refractories. 1930-59. 569 refs. Supplemented by SB-503.